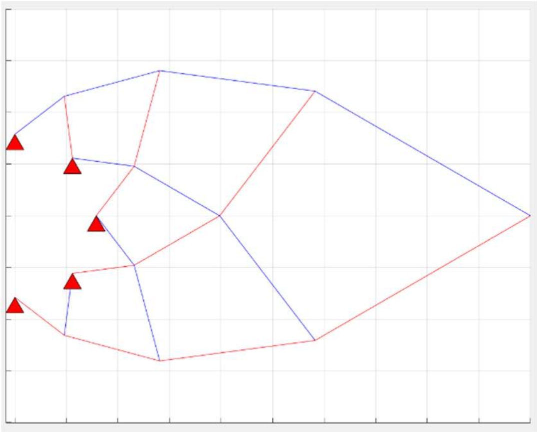
MitchellTruss4

Blue lines are strings and red lines are bars.

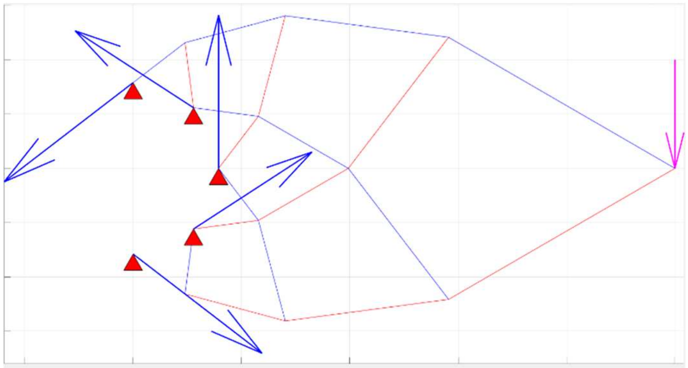


mhat=nhat=r=20

Rank of Ase is the same as mhat and nhat. Thus the truss is neither potentially inconsistent nor underdetermined, which means that it has exactly one solution. This means that no matter what set of load is applied on the truss, the force in bars and strings can be calculated with exact one solution.

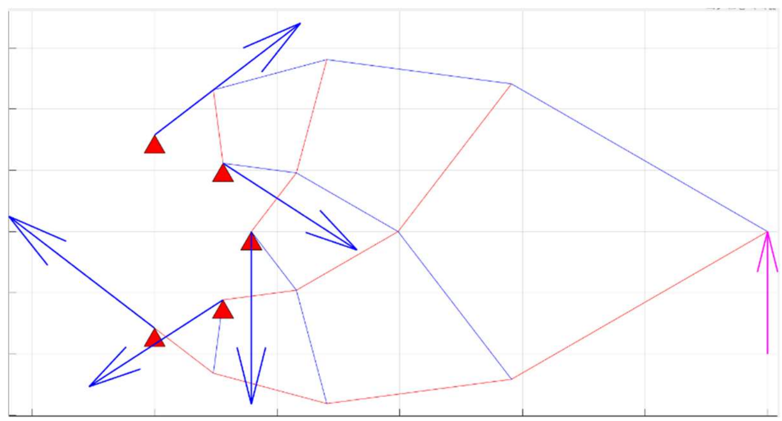
To determine the bars and strings for the design, I apply the following two external forces, which are in opposite directions, to the free end at the right of the design. The results show that connections curving upward have the same kind of forces and connections curving downward have the opposite. Therefore, the blues are set as strings in tension and red lines are set as bars in compression.

Load 1



```
c_bars =

    1.5004    1.0000    1.1448    1.3106    1.0262    0.4419    0.7011    0.8890    0.5059    0.5791


t_strings =

    1.5004    1.0000    1.1448    1.3106    1.0262    0.4419    0.7011    0.8890    0.5059    0.5791
```

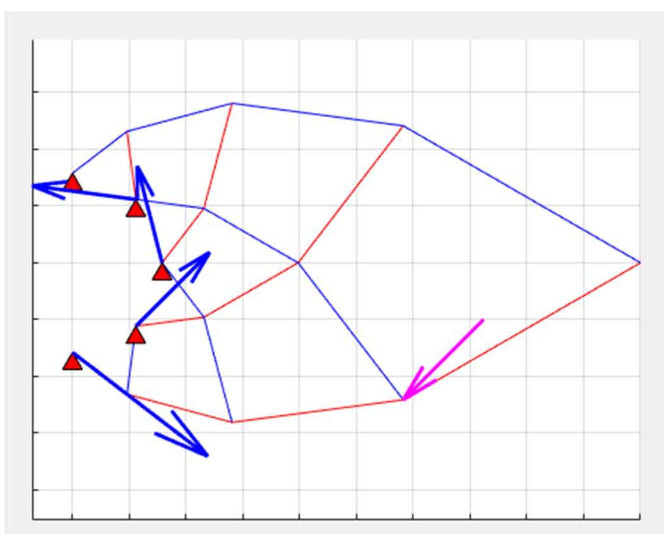
Load 2



```
c_bars =

   -1.5004   -1.0000   -1.1448   -1.3106   -1.0262   -0.4419   -0.7011   -0.8890   -0.5059   -0.5791


t_strings =

   -1.5004   -1.0000   -1.1448   -1.3106   -1.0262   -0.4419   -0.7011   -0.8890   -0.5059   -0.5791
```

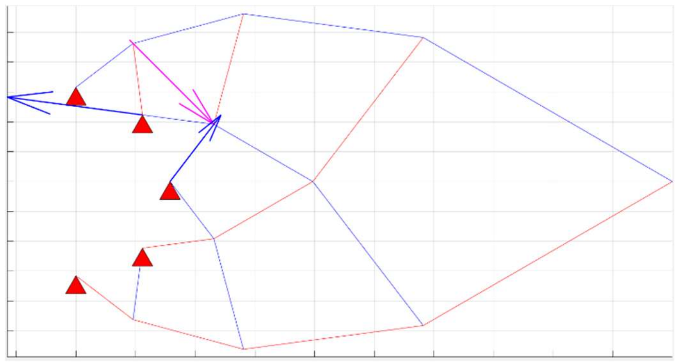
After strings and bars are confirmed I use two more different loads that might be applied to this design in real world. It's clear that are strings are in tension and bars are in compression.

Load 3



```
c_bars =

    2.1219    0.0000    1.6190    1.8535    0.8190   -0.0000    0.4393    0.5029   -0.0000    0.0000


t_strings =

   -0.0000    0.0000    0.0000   -0.0000    1.3029    0.9941    1.1381    1.0131    0.7154    0.8190
```

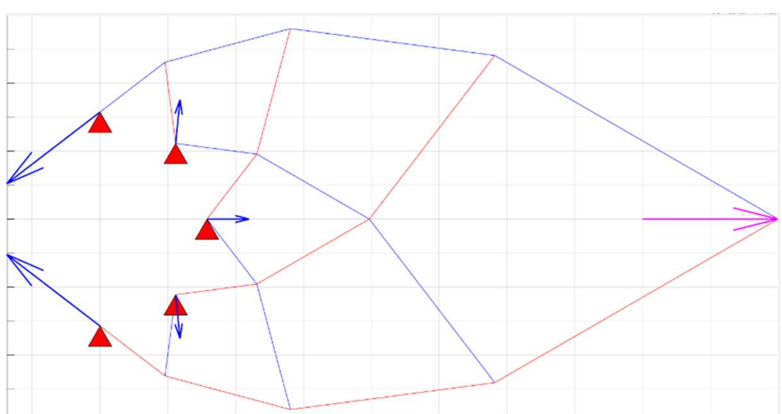
Load 4



```
c_bars =

    0.0000    0.0000    0.0000    0.0000   -0.0000   -0.0000   -0.0000    0.9941   -0.0000    0.0000


t_strings =

    0.0000   -0.0000    0.0000    0.0000    1.6190    0.0000    0.0000   -0.0000    0.0000    0.0000
```

I also try to apply this uncommon external force and this force cause some bars to be in tension and some strings to be in compression.

Load 5



```
c_bars =

   -0.8663   -0.5774   -0.6610   -0.7567    0.0762    0.2551    0.1793    0.2551    0.2921    0.3344


t_strings =

    0.8663    0.5774    0.6610    0.7567   -0.0762   -0.2551   -0.1793   -0.2551   -0.2921   -0.3344
```

NonminimalPrism4

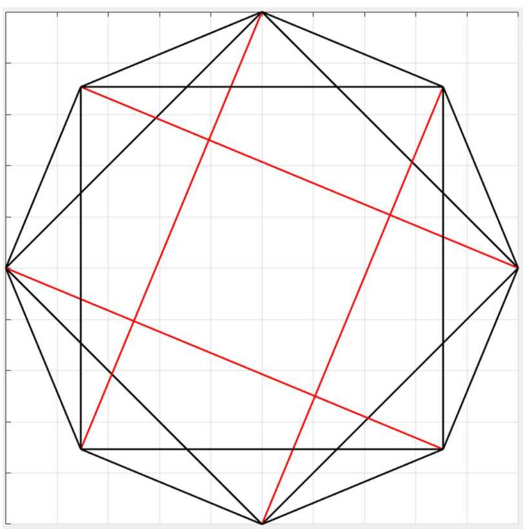
All nodes are free. Black lines are strings and red lines are bars.

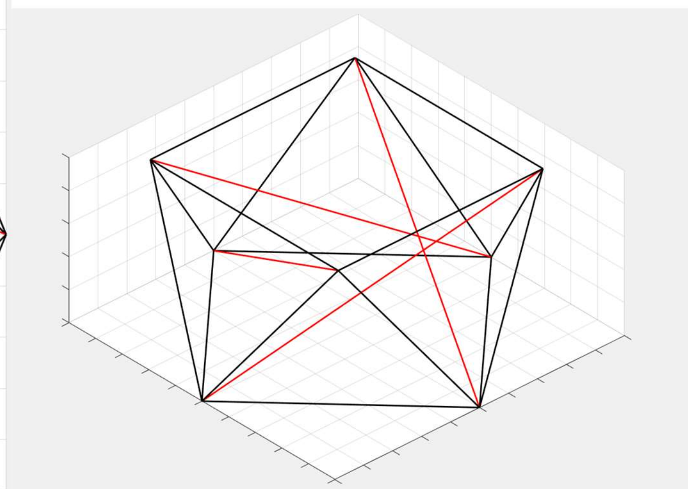
mhat=24;nhat=20;r=17

Rank of Ase is smaller than mhat. So it is potentially inconsistent, implying the presence of soft modes or instability, with 3 DOF.

Rank of Ase is smaller than nhat. So it is underdetermined.

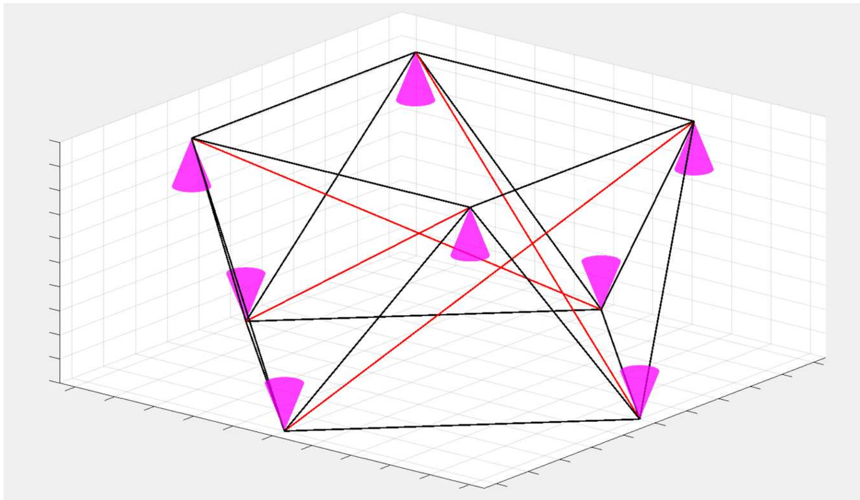
The system is both potentially incositent and underdetermined. Meaning that it might have 0 or infinite solutions depending on the load u.





By applying the following load, which is in direction of -1z for all bottom nodes and +1z for all top nodes. All strings are in tension and all bars are in compression. So it means that the system is tensionable under load.

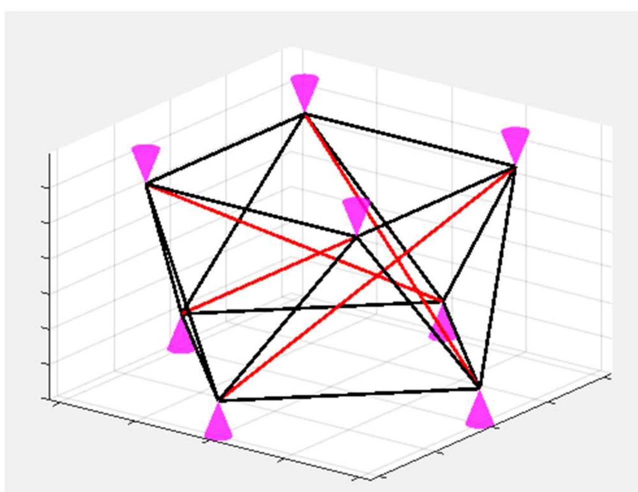
Load 1



```
c_bars =

    1.7580    1.7580    1.7580    1.7580

No bars under tension.  Good.

t_strings =

    0.6296    0.6296    0.6296    0.6296    0.6296    0.6296    0.6296    0.6296    1.6833    1.6833    1.6833    1.6833    0.6296    0.6296    0.6296    0.6296

The 16 strings are all under tension with tau_min=0.62964. Good.
```

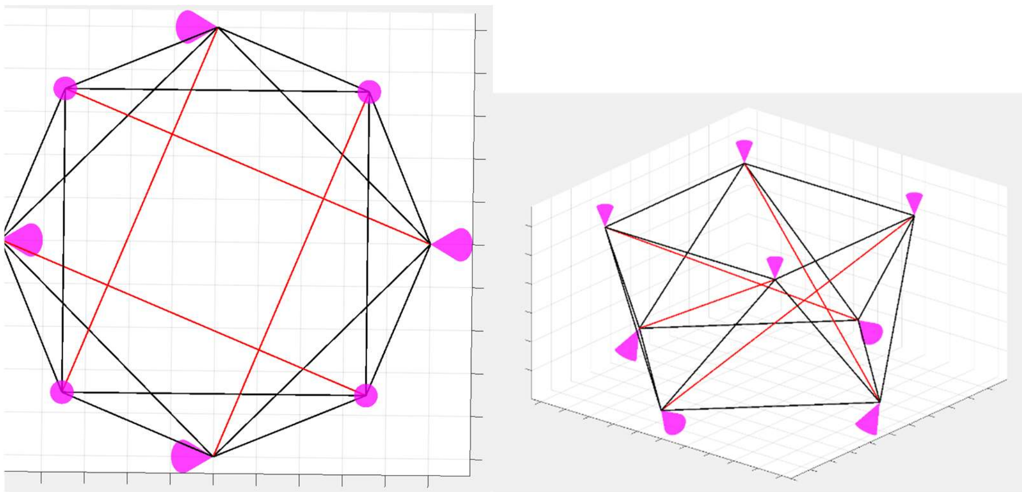

```
c_bars =

    1.7580    1.7580    1.7580    1.7580


t_strings =

    0.6296    0.6296    0.6296    0.6296    0.6296    0.6296    0.6296    0.6296    1.6833    1.6833    1.6833    1.6833    0.6296    0.6296    0.6296    0.6296
```


Load 2



```
c_bars =

   1.0e-14 *

  -0.0056    0.0458    0.1332    0.0722


t_strings =

    0.2071    0.2071    0.2071    0.2071    0.2071    0.2071    0.2071    0.2071   -0.6296   -0.6296   -0.6296   -0.6296   -0.6296   -0.6296   -0.6296   -0.6296
```

Load 3



```
c_bars =

   1.0e-14 *

  -0.1943   -0.1860   -0.1443   -0.1388


t_strings =

    0.9142    0.9142   -0.5000   -0.5000    0.2071    0.2071    0.2071    0.2071   -0.6296   -0.6296   -0.6296   -0.6296   -0.6296   -0.6296   -0.6296   -0.6296
```

singleRod with 3 strings(Figure 6.2 in book)

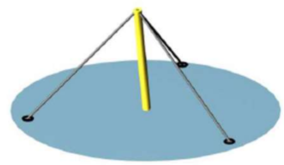


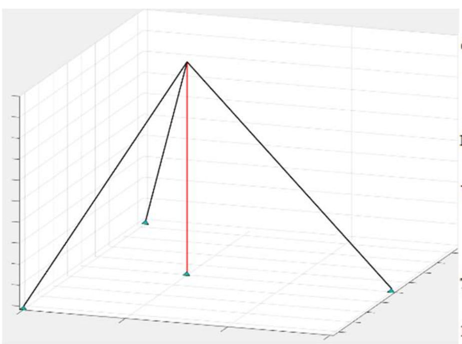
Figure 6.2: A single pinned rod and three strings.

Mhat=3;nhat=4;r=3;

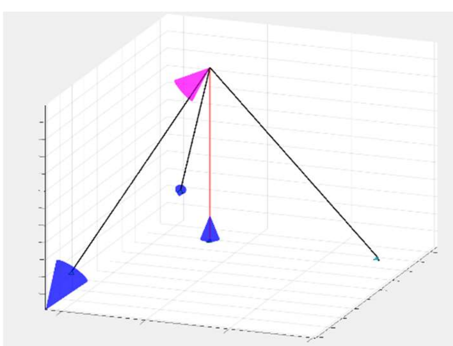
Rank of Ase is smaller than mhat. So it is potentially inconsistent, implying the presence of soft modes or instability, with 1 DOF.

Rank of Ase is smaller than nhat. So it is underdetermined. And it is pretensionable.

The system is both potentially inconsistent and underdetermined, which means that it has 0 or inifinite solutions depending on load u.



```
c_bars =

    0.2121

No bars under tension.  Good.

t_strings =

    0.1000    0.1000    0.1000

The 3 strings are all under tension with tau_min=0.1. Good.

Pretensionable!
```



```
c_bars =

    1.2121

t_strings =

    0.1000    0.6977    2.3307
```

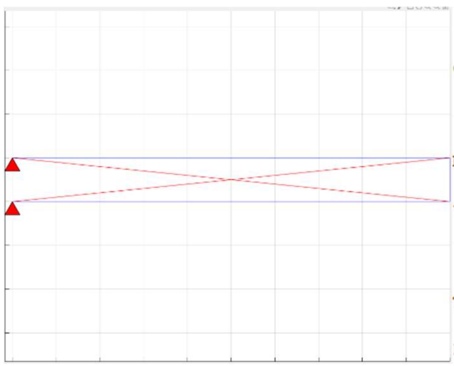
wallBar (Figure 1.39 in book)

mhat=4;nhat=5;r=4

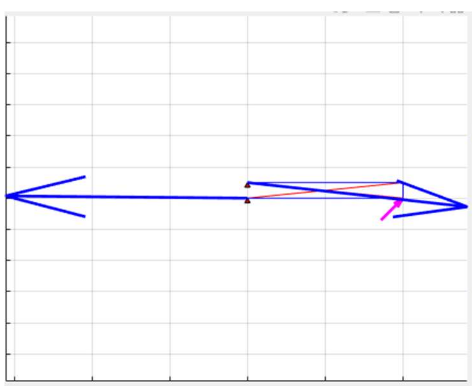
Rank of Ase is equal to mhat. So it is not potentially inconsistent.

Rank of Ase is smaller than 5. So it is underdetermined.

Thus the system is not potentially inconsistent and underdetermined. Which means that it has infinite solutions.



```
c_bars =

    1.0050    1.0050

No bars under tension.  Good.

t_strings =

    0.1000    1.0000    1.0000

The 3 strings are all under tension with tau_min=0.1. Good.

Pretensionable!
```



```
c_bars =

   11.0549    1.0050

t_strings =

    0.1000   12.0000    1.0000
```